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**SERUM LIPIDS AND LIPOPROTEINS
IN USAF ACADEMY CADETS:
OVERALL SUMMARY**

June 1977

Progress Report for Period July 1972-September 1976

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USAF SCHOOL OF AEROSPACE MEDICINE
Aerospace Medical Division (AFSC)
Brooks Air Force Base, Texas 78235



NOTICES


This progress report was submitted by personnel of the Clinical Pathology Branch, Clinical Sciences Division, USAF School of Aerospace Medicine, Aerospace Medical Division, AFSC, Brooks Air Force Base, Texas, under job order 7755-18-03.

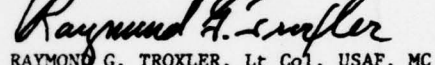
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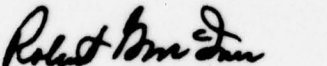
The voluntary informed consent of the subjects used in this research was obtained in accordance with AFR 80-33.

This report has been reviewed by the Information Office (OI) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.


DALE A. CLARK, Ph.D.
Project Scientist


RAYMOND G. TROXLER, Lt Col, USAF, MC
Supervisor


ROBERT G. MCIVER
Brigadier General, USAF, MC
Commander

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 14 SAM-TR-77-13	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) 6 SERUM LIPIDS AND LIPOPROTEINS IN USAF ACADEMY CADETS: OVERALL SUMMARY.		5. TYPE OF REPORT & PERIOD COVERED 9 Progress Report, Jul 1972-Sep 1976.
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) 10 Dale A. Clark, Ph.D.		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS USAF School of Aerospace Medicine (NGP) Aerospace Medical Division (AFSC) Brooks Air Force Base, Texas 78235		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 6065KO 16 7755-18-03 17 18
11. CONTROLLING OFFICE NAME AND ADDRESS USAF School of Aerospace Medicine (NGP) Aerospace Medical Division (AFSC) Brooks Air Force Base, Texas 78235		12. REPORT DATE 11 June 1977
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. NUMBER OF PAGES 12 20p.
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Identified by Frank J. Seiler Research Laboratory as report No. FJSRL-TR-77-0003.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Cholesterol levels Lipoprotein levels Triglyceride levels Uric acid levels Body composition Lipids, serum		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) During their 4-yr attendance at the USAF Academy, levels of serum lipids, lipo- proteins, uric acid, glucose, and proteins were measured in a group of cadets; body composition was estimated using a body volumeter and by anthropometric mea- surements; and dietary intakes were assessed from diet diaries. Mean serum cholesterol levels were average or below except at certain stressful times; mean percent body fat was slightly below the average for college males; and mean over- all body weight increased 4.3 kg (9.5 lb). The average subject showed no develop- ment of obesity or undue risk of cardiovascular disease.		

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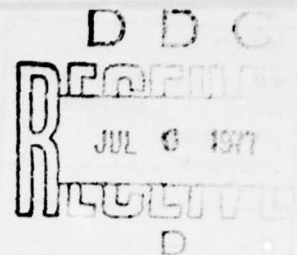
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SERUM LIPIDS AND LIPOPROTEINS IN USAF ACADEMY CADETS:
OVERALL SUMMARY

INTRODUCTION

This study of lipid and lipoprotein levels in USAF Academy cadets was prompted by an earlier study designed to determine whether serum lipid and lipoprotein levels, measured in young men, could be used to identify individuals having a high probability of premature onset of heart disease symptoms (15). That study, designated hereinafter as the West Point Study, included all members of the class that graduated from the United States Military Academy at West Point in 1956. Serum lipid and lipoprotein levels have been measured in blood drawn from these men in 1952 and every 2 years since. The study is ongoing at the U.S. Air Force School of Aerospace Medicine (USAFSAM), Brooks AFB, Texas, and interim results have been published (5).

The findings which prompted the study of serum lipids and lipoproteins in USAF Academy cadets are summarized in Figure 1. The mean levels of serum cholesterol and its primary serum transport vehicle, S_f 0-12 lipoprotein, rose markedly during the cadets' 4 years at West Point and the first 2 years after graduation. According to risk factors calculated from the Framingham Study (14) of cardiovascular disease, a rise of this magnitude in serum cholesterol would increase the risk of cardiovascular disease by a factor of 2. Whether or not this increased risk will be validated in the subjects of the West Point Study remains to be seen. In the meantime, the disturbing possibility that some factor(s) in the environment of military academies might cause a rise in serum cholesterol levels and in the risk of subsequent heart disease demanded evaluation.

One such factor may be the stress experienced by cadets in military academies. Elevated serum cholesterol levels have been reported in various groups of stressed individuals, including medical students immediately after examinations (21), tax accountants facing deadlines for filing tax returns (11), and selected experimental subjects facing an uncomfortable experience (19). Within our society, certain individuals who occupy positions that carry heavy responsibilities and high levels of stress have developed particular personality characteristics. Friedman and Rosenman (10) have characterized the aggressive, time-conscious, efficiency-oriented, ambitious individual as a Type A personality and have documented the excessive risk of heart attack associated with such personalities. Since the cluster of traits associated with Type A personality includes qualities characteristic of many good military officers, it is possible that the stress of life in military academies and the attitudes inculcated by the training regimens might converge to cause significant increase in serum cholesterol levels and in risk of

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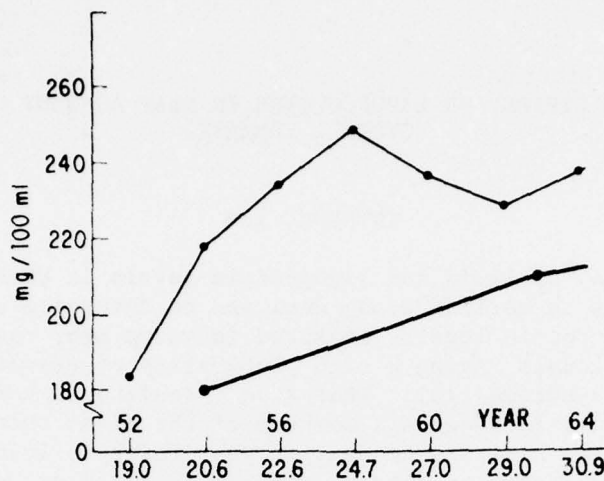


Figure 1. Mean serum cholesterol levels in subjects of the West Point Study (upper line) and in American males of comparable age (lower line, reference 16). Numbers below the abscissa denote age.

subsequent heart attacks. If so, increased risk of heart attack in later years would be a type of occupational hazard for military academy cadets. If this scenario were true, the Air Force would be training its elite cadre of future leaders in an environment that would increase their risk of heart attacks. This possibility, though theoretical, is too important to ignore. A study of serum lipid and lipoprotein levels in USAF Academy cadets was therefore begun in 1972.

PURPOSE AND GENERAL PLAN

The purpose of the study was to determine whether attendance at the U.S. Air Force Academy (USAFA) is associated with any significant increase in factors that predict risk of heart disease. Because the unfavorable changes found in the West Point Study continued for 2 years after graduation, the study of USAFA cadets was planned to include their 4 years at the Academy plus the 2 years immediately following their graduation. To provide a broad data base for interpreting any trends that might be found, measurements and/or observations of factors listed in Table 1 were included in the study insofar as feasible.

The data were collected to provide at least partial answers to the following questions:

1. During the 4-year period at the USAF Academy,
 - a. Is any increased risk of cardiovascular disease indicated by serum levels of cholesterol, lipoproteins, or triglycerides? Can stress levels in cadet life be correlated with lipid/lipoprotein levels?

b. Do cadets tend to become obese? Since average body weight is known to increase during this period, is that increase associated with an increase in the proportion of body fat? What is the average caloric intake? Can body composition (percent body fat) be correlated with caloric intake? Does the body composition indicate excessive caloric intake?

2. During the 2 years after graduation from the Academy, is there any significant increase in cardiovascular disease risk factors? If so, can any changes be correlated with stress? With weight gain or loss?

MAJOR FINDINGS

At this time, preliminary answers are available to only some of the questions pertaining to the 4 years at the Academy. The data require further analysis and study to reveal all the information they may ultimately provide. Nevertheless, the data support the conclusions that (1) some cadets experience severe psychosocial stress that temporarily elevates serum cholesterol and/or uric acid levels; and (2) in general, the subjects (a) had low levels of serum lipids or lipoproteins that showed no evidence of increased risk of cardiovascular disease, (b) had a high but not excessive caloric intake, and (c) maintained a relatively lean body composition despite consistent gains in weight. As expected, however, there were individuals who were exceptions to one or more of the above generalizations.

METHODS

Participants

From more than 1400 cadets who entered the USAF Academy in July 1972, 250 young men were randomly selected. Only those who gave an informed volunteer consent were continued in the study. Subjects were free to withdraw from the study at any time without prejudice to any USAFA activity, record, or standing. No credit was given for participation. Some attrition from the study resulted from the occasional withdrawal of a subject, but the chief drain was the result of attrition from the Academy. At the last sampling period in April 1976, 94 of the original 233 participants were no longer at the Academy; and 8 others, though still at the Academy, had withdrawn from participation, leaving a total of 131 active participants.

Blood Samples

An initial blood sample was drawn during the first week the subjects attended USAFA, in July 1972; later data and blood samples were collected during the periods in the fall, winter, and spring of each year the subjects were at the Academy. The types of data collected and the serum

TABLE 1. RATIONALE FOR DATA COLLECTION

<u>Factor</u>	<u>Reason for measuring</u>
Serum lipids/lipoprotein Cholesterol Phospholipids Triglycerides Lipoproteins VLDL, LDL, HDL	Recognized association between abnormal levels and atherosclerotic heart disease
Serum proteins	Biochemical screen for gross abnormalities including artifacts in handling/shipping of serum
Uric acid	Indicator of stress or achiever status
Glucose	Relationship between diabetes and atherosclerosis
Body composition	Reveal net metabolic effects of the interaction of dietary intake vs exercise level; help interpret lipid data
Food intake	Interaction between diet, exercise, body composition, and cardiovascular disease risk factors
Exercise level	Indicator of caloric expenditure; interaction with cholesterol and uric acid levels
Stress	Association with heart disease; interaction with cholesterol and uric acid levels
Cigarette smoking	Association with increased risk of heart disease
Blood pressure	Increased risk of heart disease associated with elevated blood pressure

analyses performed are listed in Table 1. The times when these data were gathered are recorded in Table 2. Blood samples were drawn before breakfast (with occasional exceptions for individuals who skipped breakfast), after an overnight fast (except for individuals who were not notified of their next morning's blood drawing in time to preclude a late evening snack).

After clotting, blood samples were centrifuged and serum was drawn off. An aliquot was taken for determining glucose, uric acid, and total protein. To the remainder, disodium EDTA was added as a slurry (100 mg/ml) to a final concentration approximating 1 mg/ml. After these procedures were completed, samples were refrigerated at 4°-8°C for 1 to 7 days, then packed in wet ice and shipped to Brooks AFB for analyses. Glucose, total protein, and uric acid analyses were completed within 4 days. Lipoprotein and lipid analyses were begun immediately, but time required for these procedures necessitated storing some samples at 8°C for up to 7 days, or at -20°C for up to 8 weeks for lipid aliquots. Any remaining serum was stored at -20°C.

Other Data Collection

Anthropometric measurements were made so that the body fat could be estimated by the anthropometric model of Clark (4). This model subdivides the body into seven compartments--upper and lower arms, chest, waist, hips, and upper and lower legs. Each compartment is treated as a cone or cylinder. The length, circumference at the midpoint, and an applicable skinfold were measured. From these, the volume of fat was computed and multiplied by the density of fat to provide an estimate of the weight of fat in each of the compartments. Summation of the weights of fat in each compartment gave an estimate of total body fat. In pilot studies by which the model was validated, estimates from the anthropometric model correlated well with estimates made by measurements in the body volumeter. Correlation coefficients were 0.926, 0.845, and 0.756 for the estimates of lean mass, fat mass, and percent body fat, respectively. The subjects in these validation studies were young airmen whose age and body compositions were expected to approximate the USAFA cadets in this study. The anthropometric model was expected to overestimate body fat, but to be consistent in each individual subject (4). On three occasions, body composition of the subjects in the USAFA study was estimated using a body volumeter transported from Brooks AFB to the Academy. With these values, the estimates of body composition made by the anthropometric model on each individual were calibrated.

Beginning in September 1973, blood pressure was measured either at the time blood was drawn or at the time anthropometric measurements were taken.

When subjects reported for anthropometric measurements, they were queried about their physical activity, smoking history, and other diet,

TABLE 2. DATES OF DATA COLLECTION

	Blood sample	Body volumeter	Anthropometric measurements	Dietary diary	Blood pressure histories (smoking; exercise; special, such as stress and illness)
<u>1972</u>					
Entry	5-10 Jul (232)				
Fall	11-22 Sep (201)	6-12 Sep (199)	6-12 Sep (209)		
<u>1973</u>					
Winter	16-31 Jan (175)		15-24 Jan (160)		15-24 Jan
Spring	17 Apr- 1 May (168)				
Fall	13-24 Sep (139)	10-17 Sep (147)	10-17 Sep (149)		10-17 Sep
<u>1974</u>					
Winter	22 Jan- 7 Feb (148)		21-30 Jan (141)		21-30 Jan
Spring	23 Apr- 1 May (142)		23 Apr-1 May (131)	14-24 May (54)	23 Apr-1 May
Fall	24 Sep- 1 Oct (135)		23-27 Sep (133)	24 Sep- 19 Dec (72)	23-27 Sep
<u>1975</u>					
Winter	21 Jan- 6 Feb (129)		20-28 Jan (135)		20-28 Jan
Spring	16-24 Apr (129)		16-24 Apr (114)		16-24 Apr
Fall	21-28 Oct (123)	21 Oct- 5 Nov (118)	21 Oct-5 Nov (124)	14 Nov- 4 Dec (65)	21 Oct-5 Nov
<u>1976</u>					
Winter	11-19 Feb (122)		11-20 Feb (128)		11-20 Feb
Spring	27 Apr- 6 May (132)		26 Apr-6 May (134)		26 Apr-6 May

stress, or medical factors that might affect their serum lipid levels. Appropriate notes were recorded.

Diet Diaries

At three times, subjects were requested to record their food intakes for a Tuesday-Thursday period. Forms were supplied, together with instructions to make appropriate entries after each meal or snack, and a guide for estimating the size of servings.

Complete diet diaries were sent to USAFSAM where the grams of the various food items consumed were estimated from the portion sizes indicated by the subjects. This information was coded for input to a computer which used a U.S. Department of Agriculture tape to calculate the intake of protein, carbohydrate, fat, certain vitamins and minerals, and total calories.

Analytical Procedures

Serum glucose was determined on an AutoAnalyzer using Technicon Instruments Corp. Method No. 02.

Serum uric acid was determined with an AutoAnalyzer using Technicon Instruments Corp. Method 13.B.

Serum total protein was initially measured by the method of Lowry (13), but after January 1974 it was estimated by refractometry.

Serum lipids were extracted and separated on micro silicic acid columns (12). Appropriate eluted fractions were analyzed for cholesterol, triglyceride, and phospholipid (12). Lipoproteins in the July and September 1972 samples were determined in the ultracentrifuge (8); in later samples, by agarose gel electrophoresis (18). For monitoring purposes, serum proteins were separated by disk gel electrophoresis (7).

RESULTS AND DISCUSSION

Mean serum cholesterol and uric acid levels are shown in Figure 2. Mean serum uric acid levels were markedly elevated only in the July 1972 sample. The pattern of elevation is strikingly related to the course of events during the cadets' first week at the Academy. This relationship, previously reported (6), is demonstrated in Figure 3. The normal mean value in blood drawn on the morning of 5 July contrasts with the progressive elevation in subsequent mean levels after the initiation of

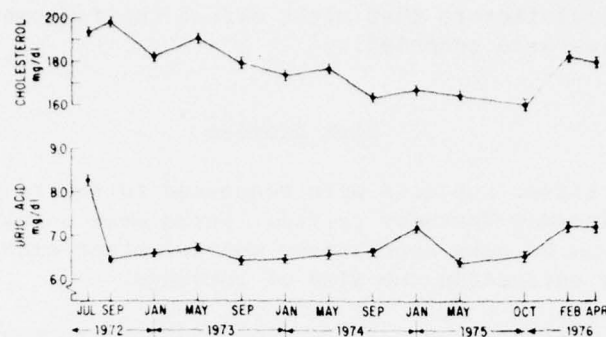


Figure 2. Mean levels of serum cholesterol and uric acid. Brackets enclose the mean ± 1 standard error of the mean.

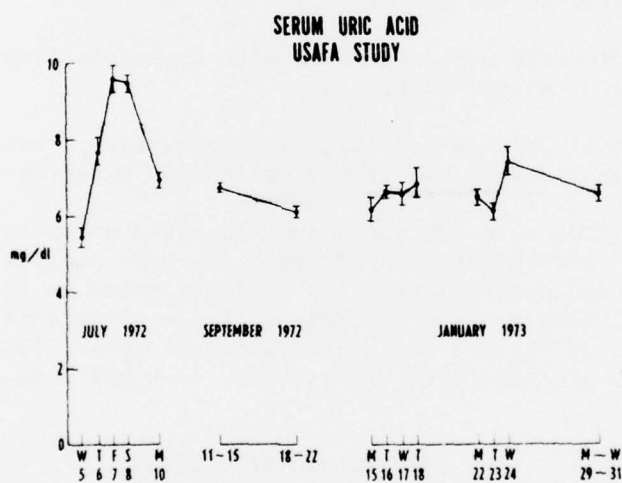


Figure 3. Mean serum uric acid levels by individual days and by sampling period (crosshatched bar) ± 1 standard error of the mean is indicated by brackets for day means and by the vertical width of the crosshatched bar for sampling-period means.

basic training in the evening of 5 July. Since the values in Figure 3 are mean values, many individual values were much higher. The proportion of individual values higher than the upper limit of normal (8.5 mg/dl) in the USAFSAM laboratory is listed in Table 3.

Presumably the lower mean for Monday, 10 July, reflects the relaxation of tension on Sunday. The causes of elevation during the first week probably include exercise and the emotional impact of that week. Several mechanisms may be involved, including inhibition of excretion of uric acid by the kidney, secondary to emotional excitement that causes elevated levels of norepinephrine in the blood. It is noteworthy that the mean uric acid level was not elevated just before the final week of intensive military training in May 1973.

The consequences of transient elevations of serum uric acid levels are unknown and may be trivial; the consequences of persistent elevations would include increased risk of gout or renal stones in addition to cardiovascular disease (9). Fortunately, elevated levels did not persist, although individuals sometimes showed transient high levels.

Serum cholesterol levels near the start and end of the study were higher than in the intervening years. The higher mean cholesterol levels in July and September 1972 and April-May 1973, coincide with the high-stress periods of (1) the first week at the Academy, (2) the imminence of the cadets' first major academic examinations, and (3) the last week of intensive military training, respectively. Such stresses would be expected to elevate the average cholesterol level (10). The lower levels in January 1973 and in the period September 1973-October 1975 compare favorably with the mean level of 178 mg/dl found among U.S. males, age 18-24, by the U.S. Public Health Service (16). The cholesterol method used in the USAFA study gives values that are 100%-105% of values given by the Abell-Kendall method used in the Public Health Study. The values in the USAFA cadets during the 1973-1975 period are therefore apparently lower than the national average.

The final two values (February and April 1976) in the USAFA study are higher than in the 2 preceding years, but are close to the average for U.S. males of that age. The reasons for the increase above previous means could include both stress (anxiety) and a shift in the balance between the intake and expenditure of calories. The particular stress being experienced by the subjects at that time was anxiety over assignments for student pilot training. For some men, this was a matter of indifference, but others were highly concerned and awaited the imminent announcement of assignments with intense interest. Most subjects were perhaps about halfway between those extremes. The impact on serum cholesterol levels, therefore, would vary with individuals, but a small overall tendency to raise the mean level seems reasonable. The possible increase in the ratio of caloric intake to caloric expenditure is suggested by (1) the trends in weight and body composition (discussed below) and (2) the realization by the subjects that they had essentially

TABLE 3. ABNORMALLY HIGH SERUM URIC ACID LEVELS

Day	Percent of values greater than		
	Upper limit of normal 8.5 mg/dl	10 mg/dl	12 mg/dl
Wed	0	0	0
Thur	26.2	14.3	4.8
Fri	72.7	38.2	10.9
Sat	71.2	35.6	8.5
Mon	16.9	5.1	1.7

reached their goal of successfully completing a 4-year course of arduous training. References to "eating out" were more frequent than earlier, and many individuals disparaged themselves for "getting fat" or "getting flabby."

The mean lipoprotein levels are shown in Figure 4. Neither the levels nor the trends are remarkable. The levels are compatible with the serum lipid levels and lend overall credence to the cholesterol measurements.

Serum glucose levels are shown in Figure 5. All the means are within normal limits for this laboratory, but the trend toward increasing values is provocative. This trend is compatible with an overall shift toward an increase in the ratio of caloric intake to energy expenditure, but this inference is only tenuous.

Total protein levels (Fig. 6) were consistently normal. The low and high values for September 1973 and February 1976, respectively, are presumed to be due to some sort of laboratory artifact.

The efforts to assess caloric intake were only partially successful. The first diet-diary period (May 1974) was unfortunately delayed until just before final examinations. Consequently, food intake varied enormously from subject to subject, and some eating patterns were irregular, almost bizarre. The average caloric intake, however, was 3267 cal/day (Table 4), which is close to the means for the September-October 1974 and October-November 1975 mean intakes of 3204 and 3544 cal/day, respectively. The close agreement of these means tends to increase confidence in the results. The degree of participation of the subjects is less than desired at any one time; in the three samplings, only 33%, 45%, and 48%, respectively, of subjects participated. A total of 117 subjects submitted diet diaries. Of these, 14 participated in all three surveys, 45 in two, and 58 in only one.

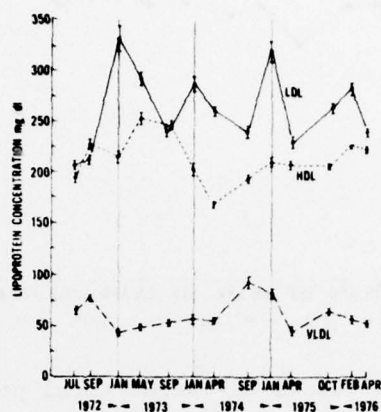


Figure 4. Mean levels of serum lipoproteins. Brackets enclose ± 1 standard error of the mean.

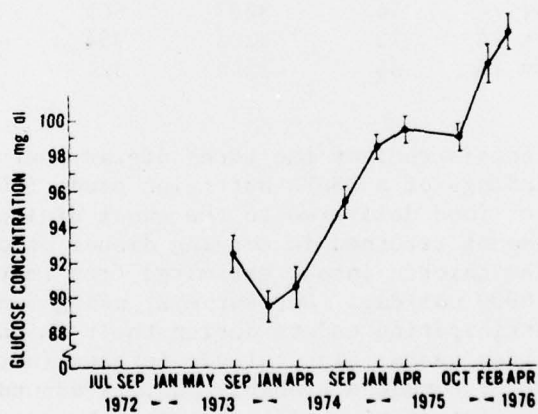


Figure 5. Mean levels of serum glucose. Brackets enclose ± 1 standard error of the mean.

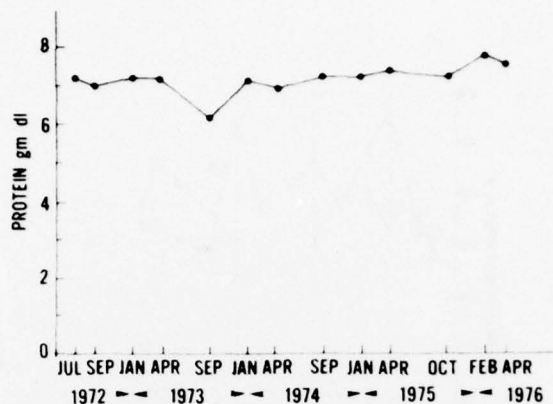


Figure 6. Mean values for serum total protein levels. The standard error of the mean was less than 0.1 mg/dl at all measurement times.

TABLE 4. CALORIC INTAKES ESTIMATED FROM DIET DIARIES

Dates	No. of subjects	Caloric intake		
		Average	Lowest	Highest
Apr - May 74	54	3267	601	7149
Sep - Oct 74	72	3204	954	7915
Oct - Nov 75	65	3544	324	7569

Despite the consistency of the three dietary surveys, the results differ from the findings of a USAFA nutrition study (20). In that study, the amount of food delivered to the cadet dining tables was observed and the amount returned in serving dishes or on the plates was subtracted. The caloric intake estimated from that nutrition study was approximately 4900 cal/day. Our surveys, using 3-day food-consumption records kept by participating cadets during their third class, second class, and first class years, give caloric intakes (noted above) that are significantly less. The reason probably centers around estimations of portion sizes. The diet diaries will therefore be reevaluated to take account of the possible underestimation of portion sizes.

The weight and body-composition data are summarized in Figure 7. To monitor body composition, standard values were obtained by the body volumeter at three times during the study (Table 2), but body composition was monitored routinely by anthropometric measurements. As expected (4),

the means for percent body fat obtained with the body volumeter were lower than the corresponding means estimated by the anthropometric model (Table 5). On the three occasions when measurements were made by the two techniques at the same time, the differences between those means were 1.8%, 2.0%, and 2.0%, respectively. The consistency of these differences supports the validity of using the anthropometric model to monitor body composition routinely when these estimates are calibrated periodically by estimates made using the body volumeter. The mean estimates of body composition plotted in Figure 7 are the raw means estimated from the anthropometric model multiplied by the mean calibration factor calculated in Table 5.

The percentages of body fat in Figure 7 reflect the lean body composition that predominated among these young men. American males in college are reported to average approximately 14% body fat (1). In the present study the subjects started with an average of 10.8% body fat after their initial 6 weeks of basic military training; thereafter the highest mean was 12.4%. That peak was recorded about 6 weeks after the start of the third class year, after the summer that included the Survival, Evasion, Resistance, and Escape (SERE) program. Most subjects interpreted this finding as reflecting the relaxation and overeating that followed the limited caloric intake during a part of the SERE training. Relaxing summer assignments and leave also were factors for some individuals. However, even after that period of self-indulgence, the average value still reflected a lean and trim body.

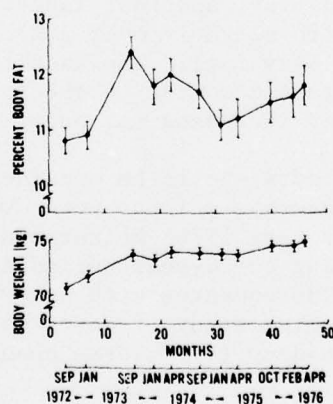


Figure 7. Mean values of body weight and percent body fat. Brackets enclose ± 1 standard error of the mean. (See text for method of estimating percent body fat.)

TABLE 5. COMPARISON OF MEANS FOR PERCENT BODY FAT ESTIMATED BY ANTHROPOMETRIC MODEL AND BODY VOLUMETER

	Simultaneous Estimation		
	Sep 72	Sep 73	Oct 75
% Body fat estimated by anthropometric model (AM)	12.582	14.401	13.504
by body volumeter (BV)	10.824	12.443	11.538
Difference (AM-BV)	1.758	1.958	1.966
Calibration factor			
Ratio $\frac{BV}{AM}$.86028	.86404	.85441
Mean		.85958	

Subsequently the average percent body fat declined slightly to a low of 11.3 in January 1975, the midpoint of the second class year. Thereafter the data show a trend toward a slowly increasing percent body fat. The average value at the time of the last sampling, in April 1976--about a month before graduation, was 11.9%, which still reflects the predominance of lean bodies among the subjects. Although the average member of this group did not get fat during the course of the study, a few approached that dubious distinction. In the last sampling, the standard deviation (SD) was 4.08% body fat; if the data were normally distributed, 5% of the observations should have been outside the range of $11.9\% \pm 8.1\%$ (mean ± 2 SD). In other words, 6 or 7 men would have had a value either less than 3.8% or greater than 20.0% body fat. In April 1976, however, no individual had less than 3.8% (two had less than 5%) body fat, and four individuals had more than 20% body fat (including two with slightly over 22%). No subject met the criterion of obesity (24% body fat). The fact that the mean percent body fat rose during the last 6 months at the Academy raises the question of whether further increases may occur after graduation.

The body composition data should be considered in relation to body weights. Since the average weights were 70.66 and 74.96 kg at the first (Sep 1972) and last (Apr 1976) measurements, respectively, the average weight change during the 4-year period at USAFA was a gain of 4.3 kg (9.5 lb). This value compares with an average weight gain of 3.9 kg (8.6 lb) in the earlier study of West Point cadets during their 4 years at the Military Academy (5). These changes are in remarkable agreement.

The tendency toward increases in body weight, percent body fat, serum glucose levels, and serum cholesterol levels in the last 4 months at the USAF Academy is compatible with some relaxation from the demanding lifestyle of the previous 4 years. Since the average percent body fat and serum cholesterol levels were still near the average for U.S. males

of comparable age, the conclusion is drawn that there is no evidence that 4 years' attendance at the Academy entails any selective increase in subsequent risk of heart disease. This finding contrasts with the implications of the increased cholesterol levels found in the earlier study of West Point cadets (5). The most probable reasons for this difference include (1) emphasis of the USAFA dining hall staff on minimizing the amount of fat in the food served, and (2) the high physical activity level carried on at altitude above 2.2 km (7200 ft).

The author interviewed the officers in charge of the dining hall at the USAF Academy (1972) and at the West Point Military Academy (1976). Both institutions now emphasize the decreased intake of fat, especially saturated fat--using low fat milk, lean meat, and vegetable oils for cooking. The USAFA dining hall staff also emphasize serving salads, fruit, and juices. These practices differ from the prevailing style of cooking in the United States (and at the Military Academy) in the fifties and earlier, when fat well-marbled meat was preferred and lard was commonly used for cooking french fries and making pastries. The fat calories, particularly saturated-fat calories, consumed by the USAFA cadets undoubtedly were a significantly smaller proportion of the total caloric intake than was true for the West Point cadets in 1952-1956.

The possible effects of the vigorous exercise program at the altitude of the USAF Academy require comment. It has been shown that vigorous exercise at altitude raises the resting basal metabolic rate for varying lengths of time (2). Severe exercise can also increase the turnover rate of thyroid hormones in the serum in experimental animals, and perhaps in men (3). This finding is compatible with the conjecture that the high level of activity at USAFA, coupled with the altitude at which the Academy is located, could cause increased thyroid activity. The latter would tend to elevate the basal metabolic rate (17) and thereby increase caloric expenditure. Since thyroid hormone levels are inversely related to serum cholesterol levels, the high exercise level at altitude and the low serum cholesterol levels may be interrelated through thyroid function. This postulation is, of course, speculative.

The nonspeculative findings of the study are:

1. Serum cholesterol (a factor of risk of cardiovascular disease) showed no sustained increase during the 4 years at the USAF Academy. In fact, the levels were below the national average during most of the study.

2. Although caloric intake was high, the average percent body fat was below the average for college men, probably because of the high level of activity/exercise/energy expenditure (augmented by altitude?) at the Academy.

3. The increases in mean values of cholesterol, percent body fat, and weight during the last 3 months may reflect relaxation from the arduous 4-year training program and suggest that further changes may be expected after graduation from the USAF Academy.

ACKNOWLEDGMENTS

This research was possible only because the cadets who participated were altruistic enough to get up early and give blood samples before breakfast; to give some of their precious free time for the measurements and interviews; to take the trouble to record all the food they ate during certain periods; and to endure the frustrations and discomforts associated with the scheduling and the measurements of body composition. The pertinent data could be obtained only through their continued voluntary participation. For his loyalty and his contributions, each man who participated in the study has the investigator's sincere thanks.

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